Appendix D: Methodology for Characterizing Trends

In order to obtain a consistent characterization of population trends in factors related to the prevention, early detection, or treatment of cancer, the joinpoint statistical methodology was used in this report (Kim et al., 2000). This methodology characterizes a trend using joined linear segments on a logarithmic scale, and has proven useful in characterizing trends in cancer incidence and mortality rates (e.g., Cancer statistics review: 1973-1997).

The joinpoint software (Joinpoint Version 2.5, 2000) uses statistical criteria to determine the fewest number of segments that are necessary to characterize a trend, where the segments begin and end, and the annual percent change (APC) for each segment (a linear trend on a log scale implies a constant annual percent change). In addition, a 95 percent confidence interval around the APC was used to determine if the APC for each segment differed significantly from zero. For the purposes of this report the maximum number of possible segments was limited to three. To avoid statistical anomalies, segments had to contain at least three observed data points, and no segment could begin or end closer than three data points from the beginning or end of the data series. For factors related to the prevention, early detection, or treatment of cancer, the data points within each series were not differentially weighted because they arose from surveys or other data sources that did not have dramatically different sample sizes across the years, and in some cases the weights would be difficult to obtain. When characterizing trends in cancer incidence or mortality, weights were used that are derived from the standard Poisson assumption. Using the results of these analyses we characterize trends with respect to both their public health importance and statistical significance. If a trend was:

- Changing less than 0.5 percent per year, we characterized it as ***STABLE*** ($-0.5 < APC < 0.5$).
- Changing more than 0.5 percent per year but less than 1.5 percent per year, we characterized it as ***RISING OR FALLING SLIGHTLY*** ($-1.5 < APC \leq -0.5$ or $0.5 \leq AAPC < 1.5$).
- Changing more than 1.5 percent per year, we characterized it as ***RISING OR FALLING*** ($AAPC \leq -1.5$ or $AAPC \geq 1.5$).
- Rising or falling at 0.5 percent per year or more, but the APC was not statistically different from zero, we noted that the trend was not statistically significant.

While these characterizations are somewhat arbitrary, they at least provide a consistent method to characterize the trends across disparate measures. By definition (since we constrained the joinpoint models to those where no segment could begin or end closer than three data points from the beginning or end of the data series), for situations in which there were four or fewer data points in the series, only one segment (i.e., a model with no joinpoints) could be fit, and for five data points only one possible joinpoint could be fit at the middle data point. To avoid these situations, for four or five data points we simply fit a regression line on the log of the response to determine the APC and its statistical significance. In one case the fit of such a line to the observed data was not good and may have been misleading. This was for "percent of high school students (grades 9-12) who were current users of cigarettes (1991-1999)," where the 1999 data point appeared to show a decline after a long-term rise. Thus the trend line was only fit through the first four data points (1991-1997). The dotted line connecting the trend line from 1991 through 1997 to the 1999 data point suggests a change in trend, which must be verified as more data accumulates. For two or three data points we connected the data points to determine the APC for each time period, and then employed a two-sample test using the survey weights to determine the statistical significance of the change in period.

References:

Kim HJ, Fay MP, Feuer EJ, Midthune DN. Permutation tests for joinpoint regression with applications to cancer rates. Stat Med 2000;19:335-351.

Joinpoint Regression Program, Version 2.5, March 2000, National Cancer Institute. http://srab.cancer.gov/joinpoint/index.html